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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/562,970	12/29/2005	Sozaburo Ohashi	126491	7899

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EXAMINER	
RUTHKOSKY, MARK	

ART UNIT	PAPER NUMBER
1795	

MAIL DATE	DELIVERY MODE
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/562,970	OHASHI, SOZABURO	
	Examiner	Art Unit	
	Mark Ruthkosky	1795	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *28 March 2008*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-9* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-9* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 3/28/2008 has been entered.

Claim Rejections - 35 USC § 102

The rejection of claim 5 under 35 U.S.C. 102(b) as being anticipated by Imahashi et al (US 5,350,643) has been overcome by applicant's amendment.

The rejection of claim 8 under 35 U.S.C. 102(b) as being anticipated by Imahashi et al (US 5,350,643) has been overcome by applicant's amendment.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1-9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Imahashi et al (US 5,350,643),

Imahashi et al (US 5,350,643) teaches a fuel cell having at least a membrane electrode assembly comprising an electrolyte membrane, a hydrogen electrode-side catalyst layer formed on one side thereof, and an air electrode-side catalyst layer formed on the other side thereof, in which the porosity of the hydrogen electrode-side catalyst layer is made to be lower than that of the air electrode-side catalyst layer (claims 1-11, col. 4, line 61 to col. 6, line 54, example 1.) The electrodes include ion-exchange materials to transfer charged ions and water, catalyst for catalyzing the fuel cell reactions that produce electricity, binder for holding the electrode together and a conductive carbon carrier for transferring the electricity. The reference establishes that the conductive carbon carrier increases electrical conductivity, but reduces ionic conductivity in the electrode, while the ion exchange resin increases ionic conductivity, but reduces electrical conductivity (see cols. 5-6 and examples 1-3.) The amount of ion-exchange resin (taught as a proton conductor in the reference) is greater in the hydrogen electrode than in the oxygen electrode (col. 7, lines 1-15.)

With regard to claim 5, example three discloses using materials having smaller particle sizes for the hydrogen catalyst electrode relative to the oxygen catalyst electrode in order to prepare a hydrogen catalyst electrode having a lower porosity (also see col. 5, lines 1-12.) The particle sizes are adjusted to fill voids in the carbon carrier paper and control the porosity of the electrode (col. 8, lines 50-45.)

The reference does not teach the volume of pore space of the hydrogen electrode-side catalyst layer accounts for 1.0% to 3.0% of the total volume of the catalyst layer and the volume of pore space of the air electrode-side catalyst layer accounts for 3% to 30% of the total volume of the catalyst layer. The reference teaches that the pore space of the hydrogen electrode is lower

than that of the oxygen electrode (see col. 4, lines 30-40 and col. 6.) It would have been obvious to one of ordinary skill in the art at the time the invention was made to adjust the volume of pore space of the hydrogen electrode-side catalyst layer to account for 1.0% to 3.0% of the total volume of the catalyst layer and the volume of pore space of the air electrode-side catalyst layer to account for 3% to 30% of the total volume of the catalyst layer, in order to adjust the flow of the fuel and oxidant gasses to the electrodes. The prior art teaches the advantages and disadvantages of increasing/decreasing the pore space in the electrode as noted in col. 6, lines 30-55.) When porosity is too high, the electrical resistance of the electrode increases. When porosity is too low, the diffusion of the reactant gas is insufficient. One skilled in the art would recognize that if a load that requires a low amount of power, less fuel is required by the fuel cell. The reference also teaches that the hydrogen diffusion into and through the electrode is high due to the smaller size of hydrogen (col. 6, lines 6-54.) Relatively lower porosity is therefore sufficient in the hydrogen electrode. The diffusion and reactivity of oxygen is relatively low so increased pore size allows for improved diffusion and reactivity. Thus, the prior art recognizes the advantages of lower porosity in the hydrogen electrode and higher relative porosity in the oxygen electrode including good diffusion/reactivity, and increased conductivity due to more conductive material. The same reasoning applies for adjusting the porosity of the oxygen electrode. From this, the skilled artesian have the knowledge to adjust the relative amount of porosity in order to obtain the desired results such as hydrogen and oxygen reactivity at the catalyst electrodes, electron conductivity through the fuel cell, ionic transfer between the electrodes and the electrolyte, and water management of the electrode/electrolyte assembly.

With regard to claim 3, the reference does not teach the weight ratio of ion-exchange resin to carbon carriers of the hydrogen electrode-side catalyst layer is greater than or equal to 1.5:1 and less than 3.0:1 and the weight ratio of ion-exchange resin to carbon carriers of the air electrode-side catalyst layer is greater than or equal to 0.4:1 and less than 1.5:1. The reference does not provide a specific weight for the carbon carriers. The reference does state in example 1 that the amount of ion-exchange material is 30 wt. % and the amount of PTFE is 30% in the hydrogen electrode, while the amount of ion-exchange material is 20 wt. % and the amount of PTFE is 20% in the oxygen electrode. It is clear that the ratio is higher in the hydrogen electrode than in the air electrode. It would have been obvious to one of ordinary skill in the art at the time the invention was made to use a weight ratio of ion-exchange resin to carbon carriers of the hydrogen electrode-side catalyst layer is greater than or equal to 1.5:1 and less than 3.0:1 and the weight ratio of ion-exchange resin to carbon carriers of the air electrode-side catalyst layer is greater than or equal to 0.4:1 and less than 1.5:1 in order to give an electrode having an increased porosity on the oxygen electrode. The reference teaches that the hydrogen diffusion into and through the electrode is high due to the smaller size of hydrogen (col. 6, lines 6-54) that the diffusion and reactivity of oxygen is relatively low due to the larger relative size of oxygen, and that increasing the pore size allows for improved diffusion and reactivity. Further, water management in the electrode is taught such that increasing the amount of the ion-conductor or porosity will improve the flow of water from the oxygen electrode to the electrolyte membrane (see col. 6, lines 6-54 and col. 5, lines 9-50.) The invention prevents water from clogging the pores. Thus, the prior art recognizes the advantages of increasing the amount of ion-exchange resin improving water flow and lowering porosity, as well as the limitations of increased porosity

(such as increased resistivity due to lesser amounts of conductive material.) From this, the skilled artesian has the knowledge to adjust the relative amount of each material in order to obtain the desired results.

With regard to claim 6, the reference does not teach the average particle diameter of the additive is less than or equal to 0.3 μm. Example three discloses using materials having smaller particle sizes in the hydrogen catalyst electrode relative to the oxygen catalyst electrode in order to prepare a hydrogen catalyst electrode having a relatively lower porosity. The reference also teaches that adjustment of porosity can be achieved by changing particle sizes of the electrode material and the amount of the material (see col. 5, lines 1-12.) From these teachings, it would have been obvious to one of ordinary skill in the art at the time the invention was made to use a particle size having average particle diameter of less than or equal to 0.3 μm in order to reduce the porosity of the hydrogen electrode so the flow of hydrogen is sufficient for reactivity at the negative electrode and the electrical conductivity of the electrode is improved due to greater amounts of carbon carrier. The prior art recognizes the advantages of smaller sized materials in the hydrogen electrode for decreasing porosity, the design of gas diffusion and reactivity, and increased conductivity due to more conductive material. From this, the skilled artesian has the knowledge to adjust the relative material size in order to obtain the desired results.

With regard to claim 8, the reference does not teach the method of spraying the catalyst, however, MPEP 2113 states, "Even though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even

though the prior product was made by a different process." The porosity of the hydrogen electrode-side catalyst layer is lower than that of the air electrode-side catalyst layer. The artesian would have found the claimed invention to be obvious in light of the teachings of the references.

Response to Arguments

Applicant's arguments filed 3/28/2008 with respect to the claims have been considered but are not persuasive. The rejections have been altered to reflect the amendments to the claims.

Applicant argues that to establish a prima facie case of obviousness, the Office Action must at least demonstrate that there is some suggestion or motivation to modify the reference. Applicant adds that the mere fact that references can be modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination. This argument is not persuasive.

The Imahashi reference teaches that the pore space of the hydrogen electrode is lower than that of the oxygen electrode (see col. 4, lines 30-40 and col. 6.) The prior art teaches the advantages and disadvantages of increasing/decreasing the pore space in the electrode as noted in col. 6, lines 30-55.) When porosity is too high, the electrical resistance of the electrode increases. When porosity is too low, the diffusion of the reactant gas is insufficient. The reference also teaches that the hydrogen diffusion into and through the electrode is high due to the smaller size of hydrogen (col. 6, lines 6-54.) Relatively lower porosity is therefore sufficient in the hydrogen electrode. The diffusion and reactivity of oxygen is relatively low so increased pore size allows for improved diffusion and reactivity. Thus, the prior art recognizes the

advantages of lower porosity in the hydrogen electrode and higher relative porosity in the oxygen electrode including good diffusion/reactivity, and increased conductivity due to more conductive material. From this, one of ordinary skill in the art would be motivated to adjust the volume of pore space of the hydrogen electrode-side catalyst layer to account for 1.0% to 3.0% of the total volume of the catalyst layer and the volume of pore space of the air electrode-side catalyst layer to account for 3% to 30% of the total volume of the catalyst layer, in order to adjust the flow of the fuel and oxidant gasses to the electrodes.

Applicant respectfully asserts that the specification of the current application suggests the criticality of the volume of pore space of the hydrogen electrode-side catalyst layer having a range of 1.0% to 3.0% of a total volume of the catalyst layer. For example, Applicant notes that the current specification demonstrates suppression of direct combustion reaction and generation of hydrogen peroxide is obtained when the volume of pore space of a hydrogen electrode-side catalyst layer accounts for 3% of the total volume of the catalyst layer at page 3, lines 20-24, page 4, line 24 - page 5, line 4, and page 8, lines 11-17 and Figs. 2 and 3. This argument is also not persuasive. Criticality is not established for a volume of pore space of the hydrogen electrode-side catalyst layer having a range of 1.0% to 3.0% of a total volume of the catalyst layer. First, the claims are not commensurate in scope with the data of the disclosure. As noted on page 4 of the specification, "in the case of a generally used solid polymer fuel cell, the volume of pore space of an air electrode-side catalyst layer accounted for 3% to 30% of the total volume of the catalyst layer. In this case, the expected purpose was fully accomplished when the volume of pore space of a hydrogen electrode-side catalyst layer accounted for 1.0% to 3.0% of the total volume of the catalyst layer. The claims do not require an air electrode-side catalyst

layer accounted for 3% to 30% of the total volume of the catalyst layer. Second, the result is not unexpected. By using a smaller pore volume, one would expect a lower porosity will suppress the direct combustion reaction or the generation of hydrogen peroxide in an air electrode-side catalyst layer compared with a fuel cell in which the porosity of a hydrogen electrode-side catalyst layer is of the same degree as that of an air electrode-side catalyst layer. Imahashi teaches a lower pore volume for the hydrogen electrode as compared with the air electrode. By using a smaller pore volume, less hydrogen may diffuse through the fuel cell. The reference teaches the advantages and disadvantages of increasing/decreasing the pore space in the electrode as noted in col. 6, lines 30-55.) When porosity is too high, the electrical resistance of the electrode increases. When porosity is too low, the diffusion of the reactant gas is insufficient. The reference also teaches that the hydrogen diffusion into and through the electrode is high due to the smaller size of hydrogen (col. 6, lines 6-54.) Relatively lower porosity is therefore sufficient in the hydrogen electrode. Thus, when a volume of pore space of an air electrode-side catalyst layer is set to be 3% to 30% of the total volume of the catalyst layer, one skilled in the art would be motivated to use a smaller hydrogen electrode-side catalyst pore volume. A hydrogen pore volume of 1.0% to 3.0% is less than 3%, which is the low end of the claimed range for the air electrode. The motivation for using this volume is found in Imahashi, which teaches a lower pore volume for the hydrogen electrode as compared with the air electrode.

Applicant argues that Imahashi fails to teach or suggest modifying the preferred porosity of 35%- 65% to the claimed range of 1.0% to 3.0% of actual volume. Applicant notes that the

porosity has a range of preferably about 35 to 60% for the hydrogen electrode and about 40 to 65% for the oxygen electrode."

This argument is not persuasive. Imahashi teaches that the porosity of the hydrogen electrode is lower than that of the oxygen electrode and the advantages and disadvantages of increasing/decreasing the pore space in the electrode. When porosity is too high, the electrical resistance of the electrode increases. When porosity is too low, the diffusion of the reactant gas is insufficient. One skilled in the art would recognize that if a load that requires a low amount of power, less fuel is required in the fuel cell. The pore volume is altered for specific uses required by the fuel cell. Thus, one would adjust the pore volume to generate electricity in a desired amount.

The reference also teaches that the hydrogen diffusion into and through the electrode is high due to the smaller size of hydrogen (col. 6, lines 6-54.) The diffusion and reactivity of oxygen is relatively low due to the larger size of oxygen, so increased pore size in the air electrode allows for improved diffusion and reactivity. Relatively lower porosity is therefore sufficient in the hydrogen electrode. Thus, the prior art recognizes the advantages of lower porosity in the hydrogen electrode and higher relative porosity in the oxygen electrode including good diffusion/reactivity, and increased conductivity due to more conductive material. From this, the skilled artesian clearly has the knowledge to adjust the relative electrode porosity in order to obtain the desired results such as hydrogen and oxygen reactivity at the catalyst electrodes, electron conductivity through the electrodes and fuel cell, ionic transfer between the electrodes and the electrolyte, and water management of the electrode/electrolyte assembly. One

skilled in the art recognizes that a balance of reactants is required to generate the required amount of energy, while not wasting fuels.

Applicant further argues that the current application is aimed to reduce the amount of hydrogen that permeates through an electrolyte membrane. According to the current application, applicant notes, the reduction of the amount of hydrogen that permeates through an electrolyte membrane would suppress the direct combustion reaction with hydrogen and the amount of hydrogen peroxide to be generated, thereby improving fuel cell service life.

In response, it is again noted that the amount of hydrogen is directly related to the amount of oxygen used in the fuel cell. One skilled in the art would require less hydrogen volume when small amounts of electrons are needed from the fuel cell to power a device, such as an automobile. The stochiometric amount of fuel used is required to be balanced by the amount of oxidant required to complete the fuel cell reaction. Since the diffusion and reactivity of oxygen is relatively low due to the larger size of oxygen, an increased pore size in the air electrode allows for improved diffusion and reactivity, as taught in Imahashi. If more electricity was desired, more volume of fuel would be required. The prior art teaches the advantages and disadvantages of increasing/decreasing the pore space in the electrode as noted in col. 6, lines 30-55.) When porosity is too high, the electrical resistance of the electrode increases. When porosity is too low, the diffusion of the reactant gas is insufficient. One skilled in the art would recognize that if a load that requires a low amount of power, less fuel is required by the fuel cell.

Examiner Correspondence

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Mark Ruthkosky whose telephone number is 571-272-1291. The examiner can normally be reached on FLEX schedule (generally, Monday-Thursday from 9:00-6:30.) If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Patrick Ryan can be reached at 571-272-1292. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free.)

/Mark Ruthkosky/

Primary Examiner, Art Unit 1795